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(54) Laterally-leaning three wheeled vehicle.

(57) A three wheeled vehicle comprising a single wheel (30) mounted on a chassis (8) connected to two substantially parallel wheels (1) by means of an articulated suspension and a handlebar (17) mounted on steering means (31) connected to the chassis (8) and to at least one of said wheels (30). The handlebar (17) is pivotally jointed to said steering means (31) about a substantially longitudinal axis (A), and actuating means (18) connected to the handlebar (17) transmits the rotation of the latter about the axes (A) to said articulated suspension which is subjected to an inclination relative to a medium plane with respect to said wheels. The articulated suspension comprises a rocking beam (6) pivotally connected to the chassis (8); shock absorbing rods (4) pivotally jointed to the rocking beam (6) and to supporting arms (2) of the wheels (1), a stabilizing device having a double acting cylinder (12) operated by hydraulic means by actuating means (18) moved according to the position of the handlebar (17) with respect to said longitudinal axis (A). A more natural driving is allowed similarly to the driving of two wheelers.

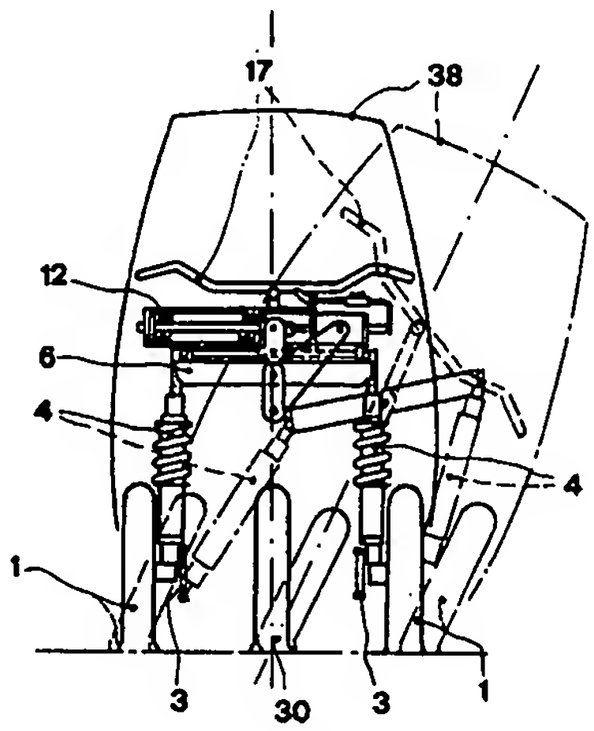

Fig. 1

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The present invention relates to a three wheeled vehicle comprising a single wheel mounted on a chassis connected with two substantially parallel wheels by means of an articulated suspension.

Three wheeled vehicles, and some types of four wheeled vehicles, owing to their reduced tread between the wheels, are not sufficiently steady with respect to tilting actions which rise in some ride conditions.

Really, three wheeled vehicles can not laterally lean as two wheelers do, in the latter centrifugal actions being balanced by a corresponding inclination of the vehicle with its dynamic loads.

In some types of three wheeled vehicles and little treaded four wheeled ones, an increase of the lateral steadiness is obtained by means of stabilizing devices which allow inclination to the vehicle in order to counteract said tilting actions.

A first type of these stabilizing devices comprises resilient means reducing the transversal stiffness thus allowing inclination to the vehicle. After the centrifugal actions are ended, the resilient means return back the vehicle to its vertical position.

This first kind of devices, which allows driving conditions similar to those possible on two wheelers, has a different resilient reaction versus different loads carried by the vehicle. For this reason the resilient means, such as the one present on a three wheeled vehicle made by Honda, is only sufficient to vertically support the stationary vehicle when the driver is not present. The weight of the latter causes the vehicle to lean if a further stand support is not provided for the driver himself doesn't hold the vehicle by a leg. In addition, the effect of aerodynamic actions, which is not negligible, causes the impossibility of equipping the vehicle with a complete body comprising a cab for the driver.

A second type of stabilizing devices comprises actuators able to lean the vehicles so as to balance aerodynamic and/or centrifugal lateral actions.

These devices can be operated by the driver himself, for example by the depression of pedals, as disclosed in U.S. patent 4484648 or, in alternative, by dynamic or positional sensors automatically controlling the leaning of the vehicle, as disclosed, for example, in International patent application WO/85/03678, where a gravity-sensitive device controls tilt actuator means.

This second type of stabilizing devices allows to equip the vehicle with a complete body and to carry different loads without varying the capacity of reaction to lateral aerodynamic and centrifugal actions.

It is an object of the present invention to provide a three wheeled vehicle having a stabilizing device of the second type, which is easier to be made with respect to the prior art and able to produce a reaction against lateral actions which can be naturally controlled by the driver with simple movements similar to the movements necessary to drive a motorcycle.

Another object of the present invention is to provide a three wheeled vehicle having sufficient lateral stiffness even when said stabilizing device is not operating or is wrongly actioned by the driver.

The above objects are reached by the vehicle according to the invention comprising a single wheel, two substantially parallel wheels connected to the chassis by means of an articulated suspension and a handlebar pivotally mounted, about a substantially longitudinal axis on steering means connected to the chassis, to at least one of said wheels. Actuating means linked to the handlebar are provided transmitting the rotation of the latter about said longitudinal axis to the articulated suspension which is thus subjected to an inclination relative to a median plane with respect to the vehicle. The handlebar, and other masses connected to it including the arms of a driver, have a barycentre substantially coincident with said longitudinal axis.

Advantageously the articulated suspension comprises:

supporting arms of the parallel wheels pivotally connected with driving shafts;

a rocking beam pivotally connected about a longitudinal axis with the chassis;

shock absorbing rods pivotally joined at their ends with the rocking beam and with the supporting arms respectively;

a stabilizing device having a double acting cylinder in which slides a piston having a stem pivotally connected to the rocking beam about a longitudinal axis;

a connecting bracket integral to the chassis and pivotally joined at its ends with the rocking beam and with the double acting cylinder; and

hydraulic means operated by said actuating means and moving the piston according to the position of the handlebar with respect to said longitudinal axis.

According to a preferred embodiment of the invention the vehicle comprises a front steering wheel and two rear driving wheels.

Further characteristics and advantages of the three wheeled vehicle according to the present invention will be made clearer with the following description of a non limiting, exemplifying embodiment, with reference to the attached drawings.

In the drawings:

- Figure 1 shows a schematic rear elevational view of the vehicle according to the invention in two ride positions;

- Figure 2 shows an elevational side view of the vehicle of figure 1;
- Figures 3 and 4 show a more detailed rear view of the vehicle of figure 1 in a vertical and a leaning position respectively;
- Figure 5 shows a detailed view of the upper portion of an articulated suspension and its actuating means of the vehicle of the above figures.

With reference to figures 1 and 2, a three wheeled vehicle according to the invention comprises a single front steering wheel 30 mounted by means of a handlebar 17 on a chassis 8 which is connected with two substantially parallel rear wheels 1 by means of an articulated suspension. The latter comprises two supporting arms 2 of said rear wheels 1 pivotally engaging with driving shafts 32 mounted on the chassis 8 and connected with an engine not shown. Chain gearings 3 transmit the motion of the engine to wheels 1.

Supporting arms 2, as also shown in figures 3 and 4, are pivotally joined, by means of a spherical hinge 2a, to the lower end 4a of shock absorbing rods 4, whose upper ends 4b are linked, by spherical hinges 5, to the ends of a rocking beam 6. The latter, by means of a central and substantially longitudinal hinge 7, is connected to the chassis 8 to which a connecting bracket 13 is integral which, at one end 13a, is hinged to a double acting cylinder 12. The stem 11 of the latter is longitudinally hinged in 10 to a support 9 integral to rocking beam 6.

The actuating cylinder 12 (figure 5) comprises two coaxial portions 12a and 12b. The first one comprises a double effect piston 14 integral to stem 11. Portion 12b comprises a spring 15 interposed between two end walls 15a and 15b, sliding on stem 11 each in only one direction, towards one another, and resting against two shoulders 35a and 35b provided for on cylinder 12b itself. Spring 15 is advantageously prestressed between walls 15a and 15b in order to produce a resilient load opposite to tilting actions.

The motion of piston 14 is controlled by a slide valve 25 comprising a stem 16 linked to actuating means 18.

The actuating cylinder 12 of the articulated suspension can then be operated by the driver by means of handle bar 17, which, as shown in figures 1, 2 and 5, can rotate about two different and substantially orthogonal axes A and B. The rotation about axis A, which is substantially longitudinal, allows, by actuating means 18 linked to handlebar 17, a control by the driver of the leaning of the vehicle, whereas a rotation of handle bar 17 about axis B, because of the pivotal connection of a steering axle 31 with a joint sleeve 37 integral to chassis 8, allows the rotation of the steering wheel 30.

Preferably axis A lies in correspondence of the barycentre of the masses of the handlebar 17 and the arms of the driver. In this way the centrifugal loads on these masses do not cause actions disturbing the movements necessary to lean the vehicle because the centrifugal loads moment with respect to axis A is very low.

When handle bar 17 has a clockwise rotation about axis A, stem 16 slides to the left and the pressurized fluid 23a coming from a pump 19 reaches a chamber 21 of cylinder 12a through a flexible duct 20, while, at the same time, the fluid which is present in a chamber 22 can flow through a flexible duct 24 towards a tank 23.

In this way stem 11 slides to the left and, as shown in figure 4, rocking beam 6 leans to the left thus causing wheels 1 and chassis 8 to lean to the right, according to the rotation of handle bar 17 about axis A. The stress of spring 15 acts in opposition to the pressure of the fluid on piston 14 and, for each angle of leaning of the vehicle, a proportional inclination of handle bar 17 corresponds.

With respect to the prior art vehicles, according to the present invention a more instinctive driving is possible because the leaning of the vehicle can be operated by the handle bar itself. In addition, loads caused by centrifugal actions do not hinder the driver from controlling the leaning of the vehicle by the handle bar.

With reference to figures 2 and 3, supporting arms 2 of the articulated suspension are hinged with the lower end of a rod 29 which, at the upper end, pivotally engages with an arm 28 integral with a torsion bar 26, pivotally engaging, by means of hinges 27, with rocking beam 6. Torsion bar 26 causes an increase of the lateral stiffness of chassis 8 necessary to assure a normal ride of the vehicle even if actuating cylinder 12 is off for maintenance reasons.

Torsion bar 26, indeed, moves integrally with the rocking beam 6 only when actuating cylinder 12 operates for inclination of the chassis, whereas, when this does not occur, a deformation of torsion bar 26 takes place, due to a different compression of shock absorbing rods 4, thus causing an increase of lateral stiffness of the vehicle in opposition to the leaning of the latter.

More precisely, if the steering is performed properly, the vehicle leans at an angle such that the resultant of the weight and the centrifugal loads acts on the median plane of the vehicle, the two shock absorbing rods 4 being equally compressed and the torsion bar 26 being not subjected to deformation. Inversely, if the steering is improperly performed, because the driver leans the vehicle not much (or too much, said resultant tends to tilt the

vehicle towards the outside (or the inside) of the curve, in this case the difference of moment of the resultant of the loads which is not balanced by the leaning of the vehicle being balanced by a different deformation of the two shock absorbing rods which cause a reaction by torsion bar 26, thus assuring to the vehicle correct ride conditions.

The articulated suspension of the vehicle according to the invention allows to mount on the latter a complete body 38 because an increase of aerodynamical actions on the body itself is balanced by an increase of the steadiness due to the leaning.

Claims

1. Three wheeled vehicle comprising a single wheel (30) mounted on a chassis (8) connected to two substantially parallel wheels (1) by means of an articulated suspension and a handlebar (17) mounted on steering means (31) connected to the chassis (8) and to at least one of said wheels (30), characterized in that said handlebar (17) is pivotally jointed to said steering means (31) about a substantially longitudinal axis (A), there being provided actuating means (18) connected to said handlebar (17) and transmitting the rotation of the latter about said axis (A) to said articulated suspension which is subjected to an inclination relative to a median plane with respect to said wheels.

2. Three wheeled vehicle according to claim 1, wherein said handlebar (17) and other masses connected to it, including the arms of a driver, have a barycentre substantially coincident with said longitudinal axis (A), whereby centrifugal actions cause loads having a very low moment with respect to said axis (A).

3. Three wheeled vehicle according to claims 1 and 2, wherein said articulated suspension comprises:

supporting arms (2) of said parallel wheels (1) pivotally connected with said driving shafts (32);

a rocking beam (6) pivotally connected about a longitudinal axis (7) to said chassis (8);

shock absorbing rods (4) pivotally jointed at their ends (4a, 4b) to said supporting arms (2) and said rocking beam (6) respectively;

a stabilizing device having a double acting cylinder (12) in which slides a piston (14) having a stem (11) pivotally connected to said rocking beam (6) about a longitudinal axis (10);

a connecting bracket (13) integral to said chassis (8) and pivotally joined at its ends with said rocking beam (6) and with a piston (14) sliding in said double acting cylinder (12);

and

hydraulic means (25) operated by said actuating means (18) and moving said piston (14) according to the position of said handlebar (17) with respect to said longitudinal axis (A).

4. Three wheeled vehicle according to the previous claims, wherein there are provided resilient means (15) coaxially counteracting with said piston (14) when sliding in said cylinder (12), comprising a spring (15) interposed between two ends walls (15a, 15b) sliding on said stem (11), each in only one direction towards one another, resting against two shoulders (35a, 35b) provided on said cylinder (12).

5. Three wheeled vehicle according to claim 4, wherein said spring (15) is prestressed between said walls (15a,15b).

6. Three wheeled vehicle according to the previous claims, wherein said hydraulic means comprises a slide valve (25) having a stem (16) operated by said actuating means (18), said valve (25) controlling the flow of a pressurized hydraulic fluid through flexible ducts (20,24) communicating with said double acting cylinder (12).

7. Three wheeled vehicle according to the previous claims, wherein said supporting arms (2) are hinged with the lower end of a rod (29) which, at the upper end pivotally engages with an arm (28) orthogonally extending from a torsion bar (26) parallel and pivotally engaging with said rocking beam (6), whereby a different compression of said shock absorbing rods (4) increases the lateral stiffness of said chassis (8).

8. Three wheeled vehicle according to the previous claims wherein said actuating means comprises two cables (18) stretched between said handlebar (17) and said hydraulic means (25,16).

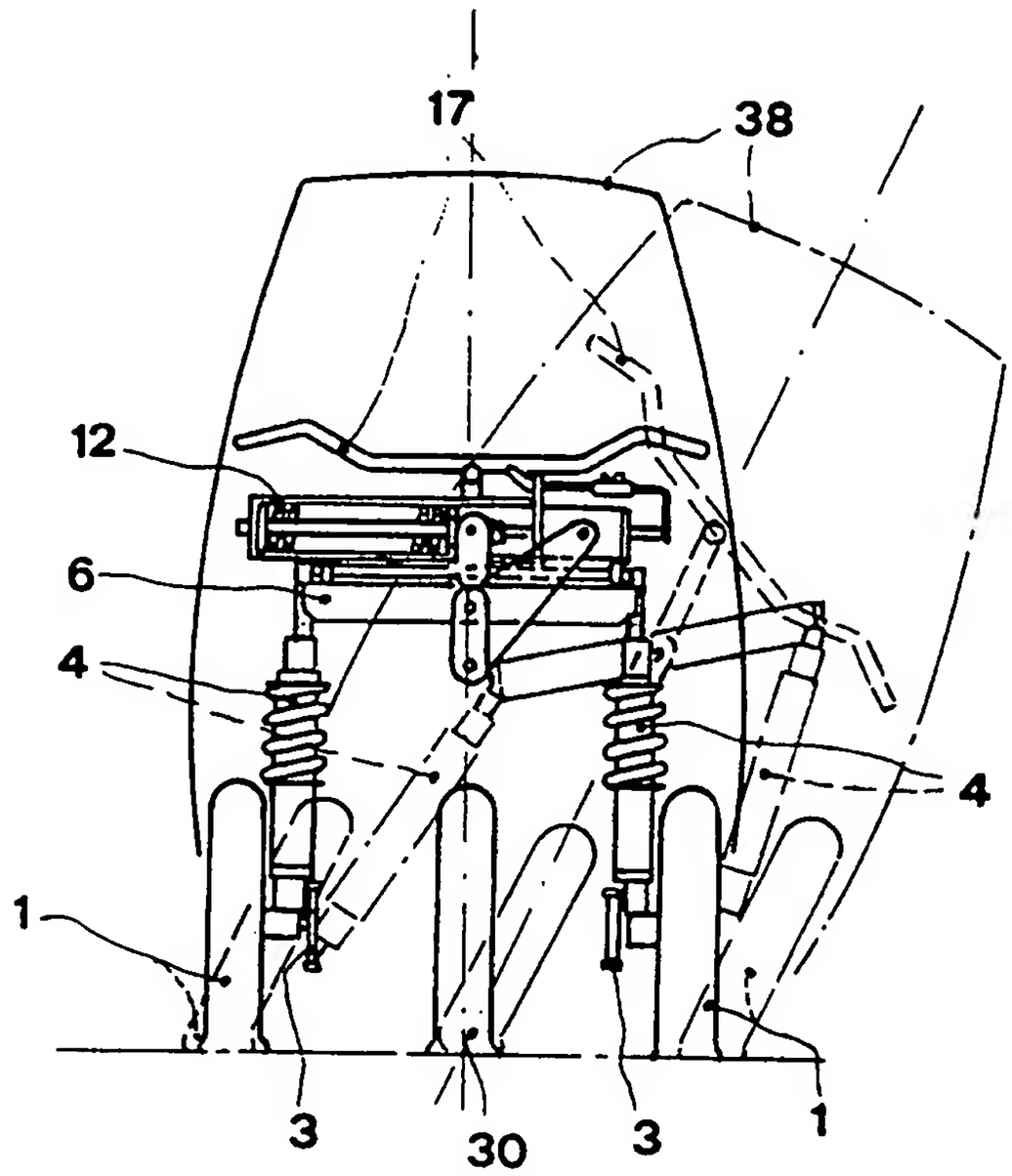

Fig. 1

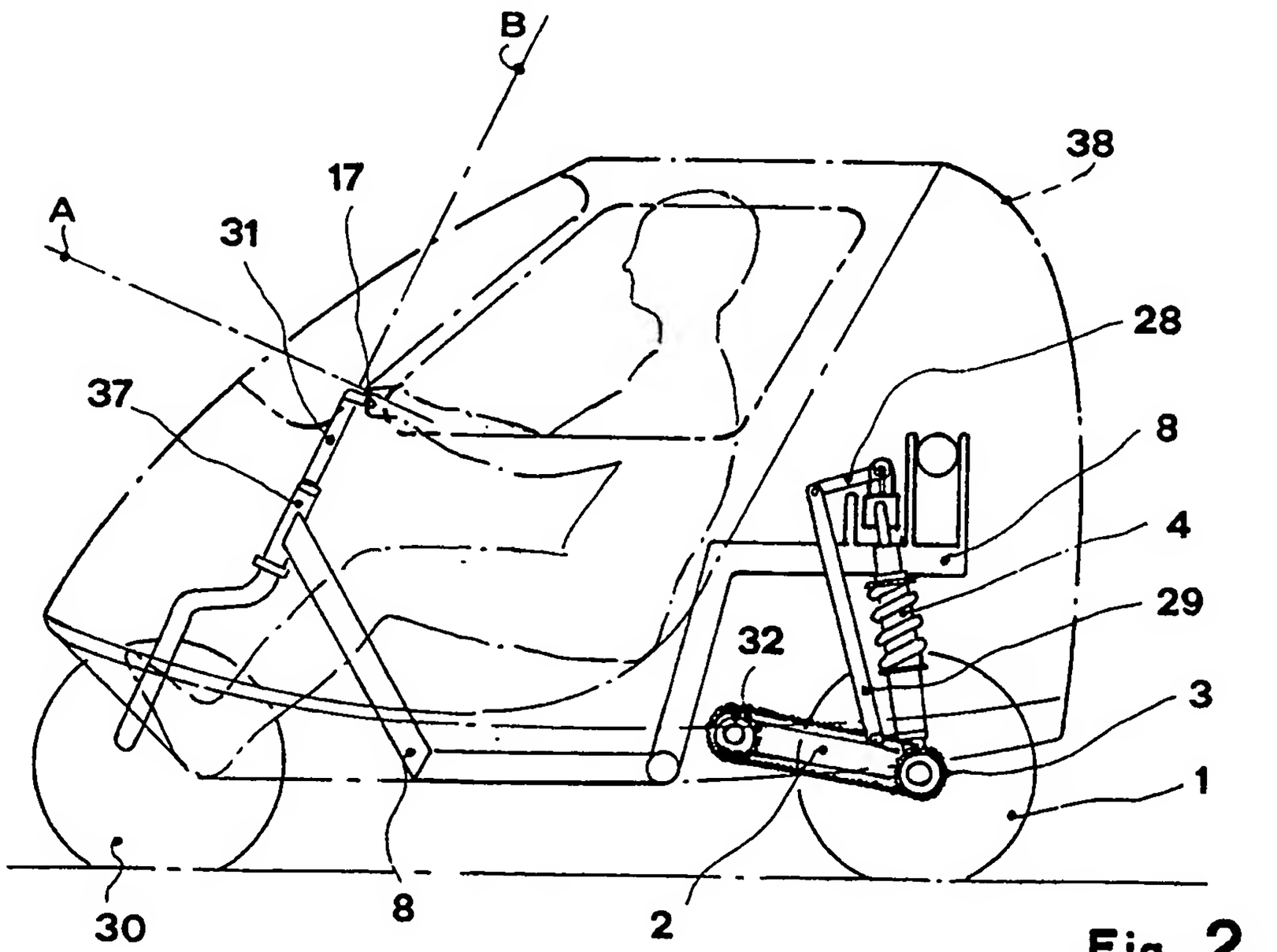

Fig. 2

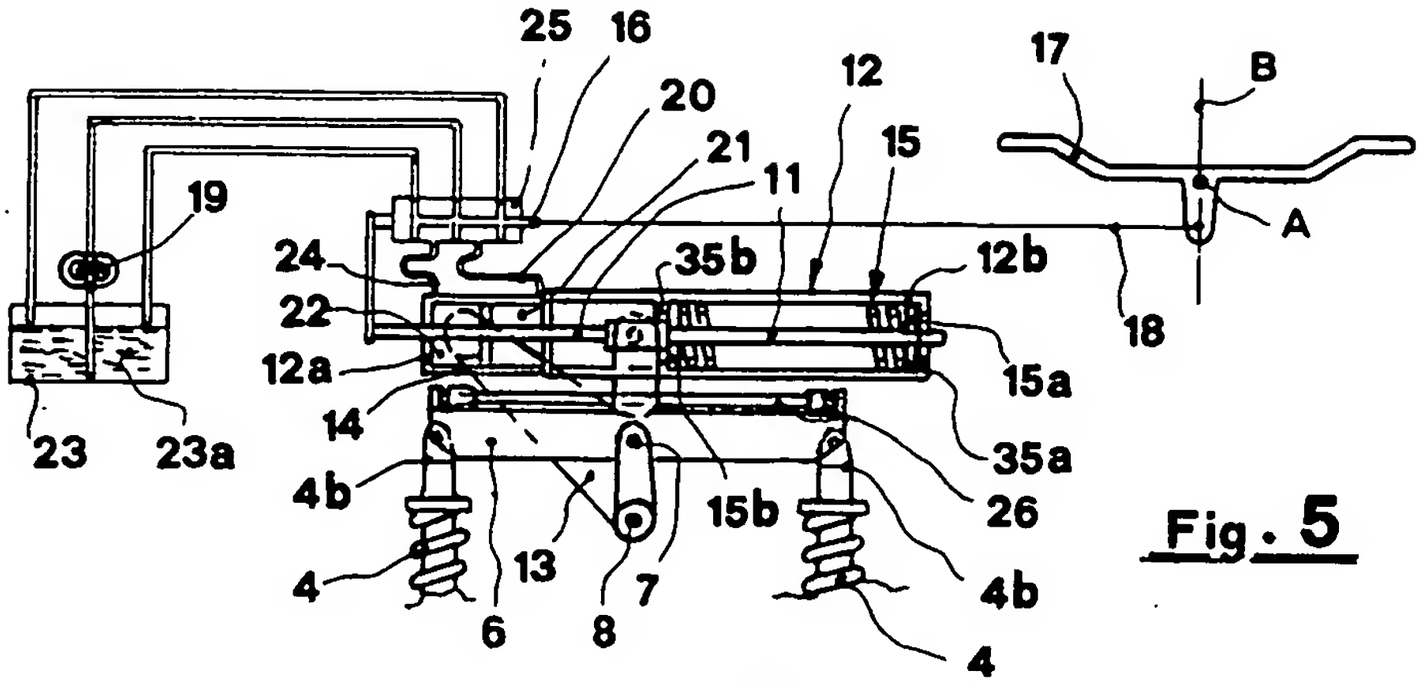

Fig. 5

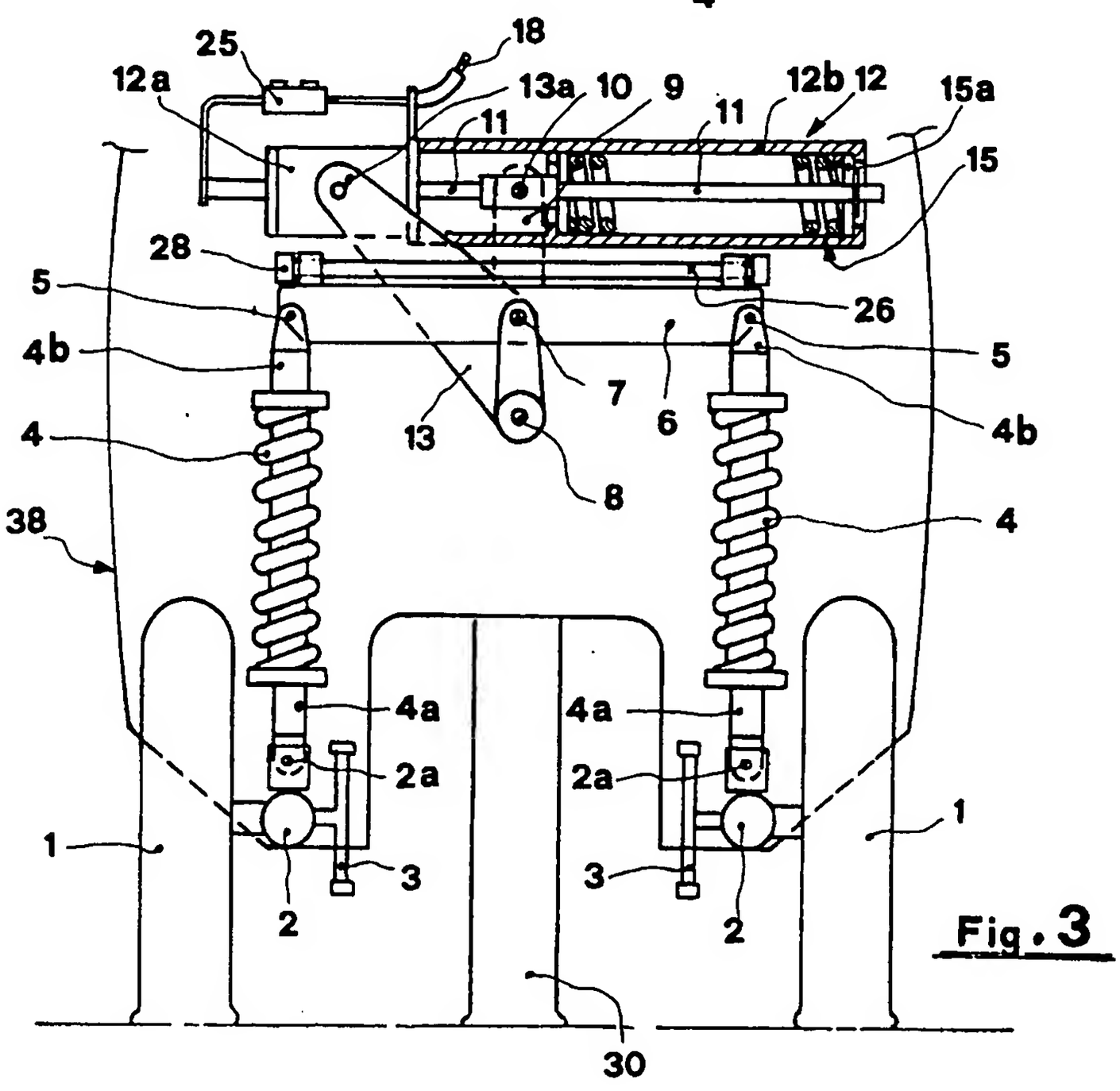

Fig. 3

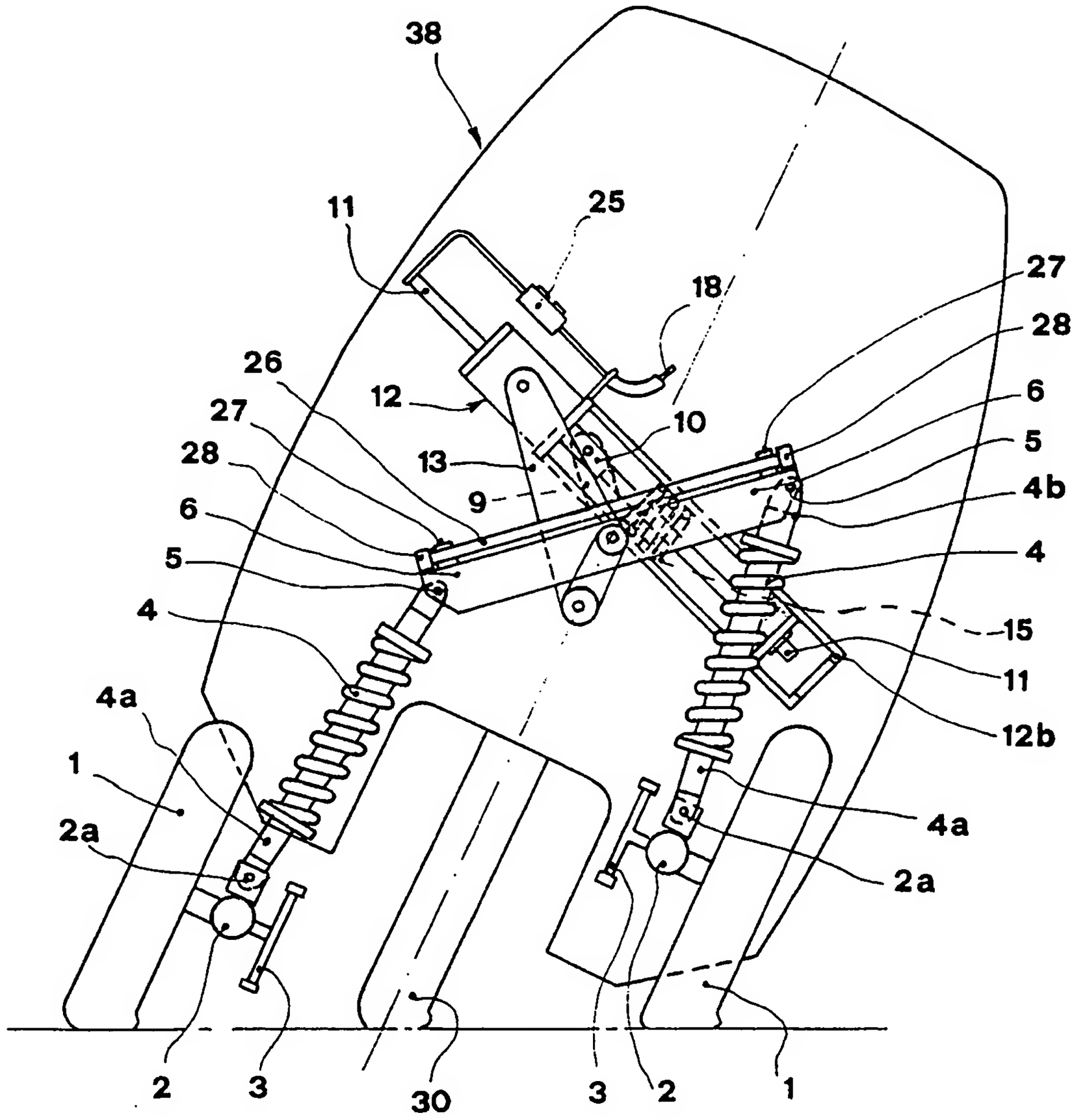

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number

EP 93 83 0236

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y A	DE-A-3 611 417 (FICHTNER) * claims; figures * ---	1 2,3,7,8	B62D9/02 B62D61/08 B62K5/04
Y A	GB-A-775 405 (DAIMLER-BENZ AG) * page 3, line 26 - line 122; figures * ---	1 2-4,6-8	
A,D	WO-A-8 503 678 (JEPHCOTT) * claims 1-4; figure 1 * ---	1,3,6	
A	CH-A-657 585 (HENGGART) * page 3, line 48 - page 4, line 5; figures * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B62D
B62K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 OCTOBER 1993	GRUNFELD M.Y.

CATEGORY OF CITED DOCUMENTS

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